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IMPROVEMENT AND MODERNIZATION OF BOATS AND FISHING EQUIPMENT TO INCREASE PRODUCTIVITY AND EFFICIENCY*

Prepared by
the FAO Secretariat

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SUMMARY

The paper identifies issues facing the harvesting sector of the fishing industry and the economic activities it generates. Measures taken to develop the industry must be tailored to the social and economic situation in each country and must take into account the fishery, manpower and material resources available.

Most developing countries have relatively large artisanal fishing sectors whose needs are quite different to, and sometimes conflicting with, the needs of the commercial fishing sector. This is evident in their traditional methods, their geographical distribution, and their general lack of capital and formal technical skills. Yet this group produces as much as 95 per cent of the fish in some major fishing countries of the developing world.

Development of large-scale commercial fishing enterprises and their supporting industries appears to be easier at first glance, but caution must be exercised before investments are made. A fishing fleet, shipyard, net factory or engine assembly plant is but one-eighth of the industrial "iceberg". The other seven-eighths, which are not visible, is the supporting network of skills, services, spare parts, communications, supplies and commercial facilities which make the operations viable and help to maintain them.

Small-scale manufacturing units, in contrast, mostly require an intermediate technology which is much less dependent on other factors. But to acquire such appropriate technology may not be easy when the industrialized countries are geared to sell the most modern or advanced types of machinery.

Thus training and the transfer of appropriate technology are vital elements in any programme of industrialization. Credit availability will also be a factor particularly when the products are for sale to the small-scale fisheries.

The issues are complex and often inter-related. No one formula will suit every situation, and each one should be viewed on its own merits. Careful study and considered selection of sectors and technologies for investment by governments and funding agencies will be rewarded with profitable industries and flourishing fisheries.

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A. INTRODUCTION

1. Fish production as a primary industry supports a whole range of ancillary industries in manufacturing, servicing, provisioning and maintaining the harvesting operations. In some countries, for every job on a fishing vessel there are as many as ten jobs created in support industries ashore. Both sectors are linked and in many cases depend on each other for their existence.

2. As the technical, economic and social requirements of the fishing industry change, so each support industry must adapt and update its operations if it is to effectively serve the fishery. The particular improvements needed in each country may differ according to the stage of development, type of fishery, social needs, material constraints or government priorities.

3. This paper summarizes the issues and changes, both forced and desired, which are likely to be required in the future with respect to the various sectors of the harvesting side of the fishing industry. Areas are also identified in which industrial development might be needed in developing countries if these changes are to take place. The dangers or pitfalls facing any industrialisation programme for fisheries are outlined. Careful consideration needs to be given to economic, social and technological factors to avoid wasted or unnecessary investment.

4. Similarly, the resource base of each fishery must be considered when making investments. Expansion of the fishing effort is not wise when production from any one fish stock is close to the optimum yield.

B. SMALL-SCALE FISHERIES

Background

5. Small-scale or artisanal fishing predominates in the developing world. These fisheries are characterized by high labour involvement, low capital investment, low levels of mechanization, and mainly passive methods of fishing. FAO estimates put the number of full-time small scale fishermen at around 10 million, and there may be another 5 million part-time fishermen. Together they produce over 20 million tons of fish a year, almost all of which goes for human consumption. There are probably as many as 3 million small-scale fishing boats, varying from log kattumarams through dugout canoes to relatively advanced small high speed craft. In the main, however, only a fraction are mechanized.

6. Although the artisanal fishermen are skilled in traditional methods of fish capture, their equipment is mostly simple and in some cases quite primitive. This is partly due to the lack of

capital and partly to the high investment and operating costs of some modern items of fishing gear or equipment, and the fact that not all innovations are appropriate in all cases. In general, synthetic ropes and nets are well accepted and have been used by small-scale fishermen for several decades. Propulsion engines are popular among those who can afford them, but winches, pumps and deck equipment are used by only the most advanced of artisanal fishermen. Electronic aids are similarly not in widespread use as yet. Apart from financial constraints to procurement and operation, very few of these fishermen live near workshops or servicing depots, particularly for hydraulic or electrical equipment, and many of them have had no technical instruction or exposure to these technologies.

7. Possible improvements to small-scale fishing industries lie in the fields of boat construction and mechanization. However, one of the major problems in stimulating artisanal fisheries to develop further lies in their scattered rural nature. One is faced with the need to promote the establishment and improvement of thousands of village level businesses to install, repair and service machinery or to actually construct or assemble basic units. Nevertheless, for a number of reasons changes must take place and these are discussed further on in this paper.

Technology and Energy Needs

8. It is now generally accepted by governments and development organizations that the small-scale fisheries of the world should not be viewed in isolation but rather as an integral part of their communities. For this reason, an integrated approach to artisanal fisheries development is now preferred. This involves among other things the encouragement and stimulation of ancillary village industries which include boatbuilding, net making, blacksmithery, marine mechanics, and the production of ice and packaging materials for fresh or cured fish.

9. If such village industry is to be encouraged, then great care needs to be taken in the choice of technology and the scale of production selected for a given production. The final cost of the product should not be the major determining factor. For example, it is possible to reduce slightly the cost of fishing boat hulls in some countries by manufacturing in GRP at a central plant. But that may have several unwelcome side effects. It would put many local village boatbuilders out of business, it would make local repair and maintenance difficult, if not impossible, and it would involve a large foreign currency element in the cost.

10. Thus, with some obvious exceptions which will be discussed later, technologies selected for artisanal sector industries should be such as can utilize local artisanal skills and locally available materials. In this way the whole fishing community can become economically healthy. Otherwise, despite a productive fishing fleet, a fishing village bleeds to death

economically as less and less of the production income is spent in the locality.

11. There exists considerable potential for tapping local natural or renewable sources in the selection of energy for small-scale fisheries. Most small-scale fisheries power needs are modest and therefore energy sources which would be inadequate for the commercial sector can be usefully and economically utilized for capture, processing or transport.

12. In 1981 the Asian Development Bank staged a workshop to draw attention to the possible application of non-conventional energy systems to artisanal fishery projects. Among the energy systems found to be applicable to artisanal fisheries were wind power (for vessel propulsion and water pumping), solar power (for fish drying, salt production and cooling), producer gas from charcoal (to drive diesel or gasoline engines), alcohol (to fuel gasoline engines), methane or biogas (to drive engines or provide lighting) and agrowaste (as fuel for stoves and boilers). No one alternative source could compete with petroleum for ease of use or versatility, but an appropriate mix of alternative energy could provide power for a fishing community at a fraction of the capital and operational costs of petroleum based systems.

Boat Building Materials

13. Traditionally, practically all small fishing boats have been built from tropical hardwoods. The most basic canoe, the dugout, has required very large trees for its construction. These large trees, and tropical hardwoods in general, are becoming scarce and there is a growing worldwide awareness for the need for conservation of the forests. There is little likelihood of supplies of suitable timber being available in the quantities required in the near future, and for this reason new boat building materials and methods will have to be introduced. These may be related to construction in glass reinforced plastics (GRP), ferro-cement, steel, or even soft woods, properly cured and well preserved, as well as marine plywoods.

14. While the use of these materials will make the small-scale fisherman more dependent upon the manufacturing and support industries, opportunities will develop for the introduction of manufacturing processes in some countries.

15. In countries where boatbuilding timber is still available there is need to produce non-corrosive fasteners. Much valuable quality timber is wasted because easily corroded nails and bolts are used. The vessels so constructed last only half as long or less than they would if proper fastenings were used. These include copper nails, brass or bronze bolts and galvanized nails and bolts. The introduction of simple zinc baths would be a big improvement to small boat yards, as would be the supply of brass, bronze and copper fittings.

Mechanization

16. Most artisanal fishing boats are propelled only by sail or paddle and, indeed, many will continue to be powered in this way for many years to come. This is inevitable, since most artisanal fishermen are landless, relatively poor, and they do not attract credit easily. In addition, mechanization may not be appropriate technology for social and economic reasons. However, in some cases mechanization is desirable and appropriate and this is particularly so in competitive circumstances. Nevertheless, mechanization programmes must be carefully prepared, they must not decrease employment opportunities for the fishermen and increase reliance on fossil-based fuels with the attendant problems of cost and availability. Similarly, the availability of supplies of equipment, spare parts and service as well as training programmes for the transfer of new technologies must be assured.

17. Experience in meeting the above-mentioned problems is available and FAO is currently working closely with manufacturers on the introduction of low-powered fuel-efficient diesel engines in small craft, mechanization of fishing gear handling and in the use of alternative energy to fossel-based fuels.

Standardization

18. By the very number of units involved, the mechanization of small-scale fisheries lends itself to standarization and the fishermen should benefit from low manufacturing and operating costs. However, selection of the technology on which the mechanization will be based must be sound and appropriate. Too many times in the past the introduction of unproven vessels, too sophisticated equipment or energy expensive motors has done much harm and resulted in disappointment or disillusionment. Technologies must be readily absorbed by the local pool of skills and in general materials should be locally available. Such technologies must be economically viable, and not create more costs than income.

19. Admittedly, standardization responds to a large demand and is best determined nationally or regionally, but it must be arrived at carefully on the grounds of power requirements, vessel types and size of market. Past attempts have not been encouraging but an example of how to approach standardization of marine engines is seen in the meeting held in Sierra Leone (15-18 November 1986) between representatives of government, fishermen, industry and FAO advisors. The precise needs of the fishing fleets were examined together with maintenance and repair service requirements, narrowing the field down to a few suitable propulsion units. As a result, industry is cooperating in further adapting their units to local needs, having been made more aware of the market. Of course, standardization should not

result in a monopoly situation and it is encouraging that a number of manufacturers are interested in the potential market.

Equipment for Small Vessels

20. Very few of the 3 million small-scale fishing craft in the world are equipped with a magnetic compass. This is surprising when one considers that it has been a basic tool of seafarers for hundreds of years, and that it is relatively cheap and easy to use. As governments begin to pay attention to safety at sea as regards artisanal fleets it is likely they will encourage greater use of basic navigational aids like the compass.

21. Vessels which are large enough should also carry lights and if mechanized a small alternator and battery. These are simple items but they can represent a considerable advance for many artisanal fleets. Bilge pumps, either manual or powered, would also be a good safety feature. Although for most artisanal boats manual pumps would be adequate.

22. If electrical power is available, then the way is open to introduce depth sounders or fish finders. Modern transistorized or silicon cell units are remarkably compact and relatively cheap. The time may now be ripe to introduce basic low-cost units which would be useful both for navigation and for fish location provided that after sales service can be assured.

23. However, the adoption of internationally developed guidelines for safety, for training and navigation, would normally be incorporated in the fisheries laws of the States. This in itself would call for some form of control and an increase in the strength of fisheries administrations, more surveyors for example, all of which would add to the costs of managing a fishery. In the same way, small-scale fishermen would be exposed to higher operational costs without, in some cases, the guarantee of higher incomes. Therefore, care must be taken by government, multilateral and bilateral agencies, to minimise the financial burden which might be created by the upgrading of the harvesting sector of small scale fisheries.

Employment

24. If some countries with important but vastly differing fisheries are taken as examples, it can be seen how greatly employment factors differ:

	Fish production 1984 (in tons)	Number of fishermen	Post harvest workers	Nos.employed per thousand tons caught
U.S.A.	4,142,000	223,000	110,558	80
Norway	2,455,000	28,000	15,000	18
Indonesia	2,217,000	1,100,000	600,000	766
Mexico	1,103,000	120,000	70,000	172
France	738,000	21,000	11,000	43
Nigeria	373,000	250,000	166,000	1,115
Mali	54,000	45,000	30,000	1,200

25. From the above figures (which do noc include fish farmers or ancillary industry workers) it is clear that per ton of fish caught, developing countries employ many more people than industrialized states. The numbers finding work in the capture and post harvest sectors can be ten or twenty times as much as in a similar-sized fishery in a developed country. The table does not include personnel in manufacturing, finance and servicing, which would probably show less disparity, but the broad picture remains the same. Mechanization and improvement of a fishing fleet will create more jobs in shore industries, but not to the degree that would be necessary to employ all redundant fishermen if the whole fleet in a developing country were to be improved for the purpose of reducing the size of crews. Technologies to be introduced in the artisanal fisheries will have to be labour intensive for a long time to come. This is true for most but not all developing states and the degree of mechanization selected will have to be balanced with the available manpower. Some governments, such as Malaysia, do plan a reduction of overall manpower in their fishing industries, but provision is being made to redeploy the excess manpower. In the case of Malaysia, the reduction was planned in order to reduce fishing effort so that the fish stocks would be conserved.

C. COMMERCIAL AND LARGE-SCALE FISHERIES

Background

26. The number of new vessels being built for the commercial/-large-scale fisheries sector of developing countries is increasing and it is evident that in some cases the replacement of existing vessels which are old and/or obsolete is overdue. Argentina is one such country which foresees a substantial replacement programme, whereas Morocco, Angola, and Thailand have current new building programmes.

27. The size of the new vessels and technology level is determined by functional requirements and the range, power and capacity needed to prosecute a given fishery. Currently many industrial fishing vessels in developing countries differ from those in the developed countries in crew facilities, electronic

aids and mechanization, but this need not be the case in the future. International requirements on standards of construction, accommodation and safety will tend to lead to improvements. In the same way, requirements for the insurance of vessels, cargoes and crews will force change.

28. The technical and economic problems faced by operators in operating and maintaining these vessels are quite serious in countries lacking their own or nearby facilities; the problems being compounded in seeking services in another state when foreign exchange restrictions are in force. Since technical services are and will continue to be essential, the development of local facilities are vital and the extent of this development should be weighed against future demands; large facilities for a small number of vessels might not be cost effective unless other work can be attracted. More specific areas for consideration are discussed below.

Vessel construction

29. Although the production from capture fisheries is unlikely to grow substantially, production units need to be maintained, refitted and eventually replaced. The current building programmes in some countries mentioned above are not directly linked to replacement needs but more to an expansion of local interests. Whereas the case of the Argentine having to consider rebuilding, stems from the fact that the vessels of the fleet have an average age of more than 20 years. The rate at which new building will take place will of course vary from country to country, but there will continue to be a need for new vessels.

30. In parallel with the new building programmes, there is a trend towards more selfsufficiency in developing countries. In Asia and South America, many countries have the necessary basic facilities for ship building. Some developing countries are also building for export, as is the case, for example, in Brazil, Guyana, Ghana, Rep. of Korea and Singapore. Many of these shipyards started from foreign ownership or joint ventures and in most cases external assistance, both financial and technical was given. However, most are still dependent upon imported materials and in some cases assistance in design is still needed.

31. Other developing countries, are now insisting on the local construction of all fishing vessels and, while existing facilities might be adequate for small vessels, this is not necessarily true for the larger units, and further development will be required. New skills as well as equipment will be needed and such development of shipyards and support industries must be considered in the light of the overall development plan of the country. Joint ventures can play a role in assisting local yards to construct larger or more complex vessels, and to train their personnel for these more demanding tasks.

Vessel Machinery and Equipment

32. The engines, winches, refrigeration machinery and electronic equiment on a modern fishing vessel are powerful complex units that require skilled and well equipped factories to produce. It is unlikely that the fishing industry in any one developing country could justify local production of large propulsion engines. The manufacturers of those engines find the bulk of their sales in non-fishery fleets which include tugs, cargo vessels, ferries, patrol craft, coasters, oil-rig tenders, naval vessels and power stations. Only if a country has a sufficient total demand for large engines of a given size could it consider negotiating with a company to manufacture or assemble such units locally.

33. Small engines are another matter as these have widespread applications such as propulsion units, auxiliaries, and drives for agricultural pumps and machines. It may be relatively easy to arrange for local assembly or manufacture of these engines and this had been done for example in Bangladesh, Brazil, India and Singapore.

34. Winches, capstans, power blocks, line haulers and windlasses could easily be produced under licence in developing countries. Hydraulic systems as an example have become simple and reliable making their widespread adoption by developing countries overdue. Nevertheless it is important to ensure that reliable trained mechanics or engineers are on hand in each major port to service the equipment.

35. Electronic equipment, on the other hand, requires a big market to justify establishing a factory. There could be a case for regional manufacture with work shared as far as possible between neighbouring states. This is already practised in Asia, where large corporations control sub-manufacturing units in a number of developing countries. However the problem of servicing could become more serious as operators become more dependent on electronic aids to maintain fishing effort. Therefore any development in the establishment of such electronic manufacturing units must consider the responsibilities to the end user.

D. MAINTENANCE AND SHIP REPAIR FACILITIES

Background

36. Repair and maintenance facilities are an essential component of the fishing industry, yet planners and investors do not always recognize the diverse requirements of the commercial and artisanal sectors. This is particularly so in the case of the more remote fishing villages where the level of skills and the tools available barely meet the basic needs of the fishermen.

37. There are many reasons for this situation but the difficulty in attracting credit is common to both sectors and it is a factor which needs to be given greater priority if even present harvesting levels are to be maintained. In fact, many of those serving the artisanal fishermen face insurmountable problems since they are rarely able to furnish the guarantees required by the lending institutions.

38. The lack of suitable repair yards and workshops does not simply result in poor maintenance, it threatens the very existance of the operators and those on board fishing vessels. On matters of safety and seaworthiness, a greater range of fishing vessels now fall into one category or another covered by international conventions, national legislation, as well as the requirements of classification societies and marine underwriters. Adequate servicing facilities are essential if vessels are to comply with regulations. Failure to comply could lead to a vessel being legally prevented from going to sea.

Large-Scale Vessels

39. With regard to the commercial and large-scale fisheries, maintenance of the hulls requires substantial drydocking or slipping facilities, and these are not always associated with the shipyards building new vessels. As a consequence, the vessels of some developing countries are forced to seek repair facilities elsewhere, which invariably demands the use of scarce convertible currencies. However, as with new construction, repair yards must have a continuous flow of work to be self-supporting and this is rarely achieved through servicing the fishing industry alone. Indeed, of all vessels over 100 GRT, only about a quarter of the 88,000 vessels so registered are fishing vessels.

40. It would not be practical to pursue self-sufficiency in drydocks and slipways in every developing country. Some governments, however, may find it necessary to provide such facilities and to cover the operational deficit in order to ensure that its fleets of vessels continue to fish; in some cases, the foreign exchange earned on fish products might lead to an overall profit. Others may decide to use neighbouring facilities, but whatever the case may be, vessels operating from ports in the flag State must have adequate repair shops to cater for other maintenance needs.

41. It would also be necessary to ensure an adequate supply of spare parts to be held in the country in order to reduce time due to breakdowns and routine maintenance. In addition, the more sophisticated the vessels, the greater the diversity of technical skills needed to service the equipment.

42. Apart from the above, governments and institutions must provide the necessary marine surveyors to ensure that the repairers and service engineers carry out their work in an approved manner and to ensure that operators meet the required

safety standards. Countries with fleets of cargo and passenger vessels are likely to have resident surveyors but in many countries operating fishing vessels, this may not be the case. There is then the need to rely on surveyors from elsewhere until such time as nationals can be trained and become experienced enough to take over the responsibilities of a survey office.

43. The training of local labour is also essential since common sense dictates that while manufacturers have a responsibility for after-sales service, many of them cannot possibly service every country in the world. This is not however easily achieved, since a modern fishing vessel incorporates many different types of equipment requiring a wide range of skills to maintain, as can be seen from the following:

i) engineeers with university/technical institute education are required in the fields of naval architecture, refrigeration, hydraulics, cathodic protection, paint systems, electronics instrumentation and propulsion machinery;

ii) tradesmen with at least four years of an apprenticeship coupled with studies at a trades school or following a City and Guilds of London type course are needed as joiners, carpenters, fitters, welders, plumbers, platers, blacksmiths, riggers, painters and coppersmiths or brazers;

iii) specialists having served an apprenticeship and having undergone further applied training are required for the shot blasting of steel, application of epoxy resins, insulating refrigerated rooms and for the fumigation of vessels;

iv) administrative support personnel with good general education are needed to maintain the accounts, purchase materials and control stores; and

v) in addition there are government and classification surveyors employed to ensure that shipbuilding and ship repair yards meet the standards of work and safety requirements and these surveys have undergone considerable professional training.

44. Most of the above, by the nature of their skills, require equipment and tools that together amount to a formidable investment cost for the shipyard. The professionel workers are of little value without the specialists and tools and vice versa. Both the capital cost of equipping skilled workers, and the training cost of producing them should be borne in mind when planning shipbuilding and repair investments. The training would require the support of comprehensive technical colleges and training institutions.

Small-scale fishing fleets

45. Unlike the commercial sector dealt with above, the number of artisanal fishing boats in developing countries outnumber those engaged in other pursuits; and for many of the repair workshops, the fishing industry is their sole source of livelihood. Unlike their bigger sisters, small boats are less likely to be able to take advantage of repair facilities in other countries. The need for repair shops is just as important however and the closer these are to the fishing villages the better. Service facilities vary from the basic clearing in a village or on a beach with barely a sun shade, to rather well set up workshops with lathes, drilling machines and such like. Similarly, the degree of skill required varies greatly.

46. Whatever the requirement, no development programme can be effective without assuring the service of the craft and equipment. This of course, is easier said than accomplished since he who carries out the repairs is often no more credit worthy than the fishermen he serves, nor is he likely to be any better educated. It follows that the desire to mechanize and invest must be tempered by acceptance of current limitations and of the rate at which the industry can be trained to maintain and operate new equipment coupled with the impact such as upgrading would have on the community as a whole.

47. In addition, the introduction of new technology and equipment could, in some cases, lead to unacceptable maintenance and operational costs. For example, echosounders and navigational equipment utilising new technology in this age of electronics can be relatively expensive to maintain. Indeed, the cost per hour of a service engineer can be as high as US$100 if sent from the factory and even agents in developing countries charge in excess of US$50 per hour plus expenses! Not all service facilities are as expensive, but all are costly in relation to a fish finder for a small vessel which can be as low as US$350.

48. Therefore, whilst the purpose of this paper is not to give advice to manufacturers on how to give service, it is obvious that in the case of low-cost items some sort of replacement scheme should be considered in conjunction with a minimum charge.

49. Other needs have been mentioned already but it would not be imprudent to repeat these to emphasize areas in which improvement could be made.

i) small boat repair yards requiring basic skills, hand tools and the minimum of machinery;

ii) slipway facilities for boats not readily beached requiring a modest level of investment in civil engineering works and machinery;

iii) outboard engine service facilities for which mainly hand tools are required but for which a good and steady supply of spare parts is essential;

iv) covered workshops for the maintenance of inboard diesel engines and stern gears requiring light machinery and specialized test equipment for fuel systems;

v) electrical repair workshops for which basic, hand-held test equipment and hand-tools are required; and

vi) for the more advanced fleets, electronics engineering workshops which need a higher degree of knowledge/-education, and more expensive test equipment than required for the electrician.

50. Often, the above requirements are met under one roof but this is certainly not always the case and, as has already been noted, the remoteness of fishing communities often presents difficulties which are not readily overcome.

E. FISH HANDLING ON BOARD AND UNLOADING

Background

51. Fish handling on board fishing vessels in both artisanal and large-scale commercial fisheries, and subsequent unloading on beach or landing places influences fishermen's earnings to a varying extent. In many developing countries, prevailing inefficient practices lead to deterioration of the quality of the fish landed, increasing losses through spoilage and elevating the cost of the operation.

52. The technology of on-board handling in small-scale fisheries is normally simple, involving only a little training and relatively small capital investment, which in most cases should be recouped in higher earnings from better quality landed fish and the reduction of post-harvest losses. On the other hand, appropriate developments in bulk handling and on board preservation in the large-scale commercial fisheries of the developing countries have not kept pace with the rapid development in the catching techniques applied to these fisheries, particularly for the schooling small pelagics that might be intended for human consumption. Most of the catches, therefore, are often landed in a bruised and decomposed state and hence destined for reduction to fish meal with a result of economic loss.

Fish handling

53. Properly designed containers, boxes, etc., made of materials which are impervious and easily cleaned are essential. The manufacture of these in developing countries has attractive economic prospects.

54. A basic principle in maintaining fish quality is to cool fish to ice temperature as soon as possible after leaving the water. This applies to any fishery. Unless fishing trips are of very short duration, fish must be chilled on board. Insulation of fish holds on larger vessels or the use of insulated fish boxes in smaller boats would promote more efficient use of ice. Local industries can be trained and encouraged to manufacture insulated boxes and install fish hold insulation in fishing vessels of any size. In some cases it may be wise to consider the installation of refrigeration units to conserve ice especially on voyages to the fishing grounds.

55. Incorporation of chilled sea water or refrigerated sea water systems on board fishing vessels, is used in some large-scale commercial fisheries and this reduces physical damage and creates fast cooling at the same time. Such systems require servicing and maintenance.

Unloading

56. Unloading of the catch should be carried out quickly, economically and with as little damage to the fish as possible. Simple derricks and capstans, either on board or on the pier, could speed up the process greatly at very little cost. Various mechanical conveying equipment exists and some can be made in simple forms. Small local workshops could easily cope with this type of mechanization.

57. Adequate supporting facilities and relevant services available to fishing vessels at landing places can contribute much to the effective unloading of the catch to the benefit of all involved. Investment on such infrastructure by the government is very essential.

58. In many fish markets in the developing world, the fish are not weighed. They are measured in volume using a standard local basket or container which is accepted to contain a certain weight or number of fish of a certain size when full. This popular and general practice has made the introduction of proper scales in fish markets mostly unsuccessful. Conventional scales can be manufactured locally, and although these would be expected to provide merchants and fishermen with a more accurate measure of the catch, the need for such an introduction should be properly ascertained.

59. The introduction of clean water, scrubbing brushes, good drainage and a strict cleaning regime would probably do more for fish quality control than any other investment in fish markets in developing countries. Provision should also be made to wash all fish going to the market in a properly designed washer using potable water or clean seawater.

60. Fish graders are useful at landing places and the separation and selection of fish could result in higher prices for the fishermen. However, grading machinery has not been widely used and accepted in the developing countries. The machinery is simple and can be driven by electrical or mechanical power units. The bulk, if not all, of the equipment can be fabricated locally. Its introduction, however, would have to take into consideration the acceptance and implication of the prevailing local fish trade practice.

F. CONSUMABLE ITEMS AND THEIR MANUFACTURE

Background

61. Most fishing gear is now made from synthetic materials, which are an important by-product of the petroleum industry. Any increase in basic oil price affects the fisherman's gear costs as well as his fuel costs. For fishing nets, the synthetic fibres chiefly used are polyamide (nylon) and polyethylene. (Polyester and polypropylene are also used but to a lesser degree.) They are poduced in granular or pellet form which is then turned into a continuous fibre. The fibres are subsequently spun into twines and made into ropes and nets.

62. The few developing countries fortunate enough to possess oil reserves and a refinery industry may contemplate establishment of a complete manufacturing line for netting twines and ropes. Others could follow the example of some developed countries and import the granules. In both cases, however, the investment costs would be considerable since the manufacturing machinery is expensive. Additionally it is currently a highly competitive market and logically not all countries can be self-sufficient, but all could produce some items of fishing gear. There may be a case for establishment of regional factories supported by a number of countries as could be the case with economic communities.

Net-making

63. Developing countries and particularly those with small-scale fisheries could expand their cottage industries through the use of hand-operated looms for net making and simple aids to rope making. Twine would have to be imported but the looms could be readily constructed locally and although all of the needs might not be met, the benefits to the communities and the economy could be considerable.

64. In some cases the use of complex, automated looms might be justified on the basis of the demand for netting. This would need considerable investment capital and training and some countries have taken this step successfully. Others, however,

have been less successful and plants are currently underutilized mainly due to the lack of twine and in some cases the machines installed are not flexible enough to meet changes in demand for the different twine materials, twine and mesh sizes.

Hardware and Accessories

65. Floats for fishing gear are now made mainly of synthetic materials and can be produced in any shape or size. The technology is simple and it would be possible for many to manufacture most types of floats locally, even if the chemicals have to be imported, rather than importing the finished article.

66. Other fishing hardware can be produced by any good smithery, foundry or workshop, with the possible exception of high quality fishing hooks.

67. Provided that steel rods and brass or copper tubing are available, swivels and related pieces of fishing tackle can be manufactured locally. This may be done with simple tools or with modern precision machines. In countries where semi-skilled labour is cheap, the former alternative would be adequate and production volume achieved by increasing the number of manufacturing units.

Small Manufacturing Units

68. It should be noted that it is often not easy for a country to obtain simple machinery for artisanal or cottage type industry. Commercial firms, particularly those selling in the international market, seek to promote the most modern and most sophisticated units. Production of simple tools or machinery is usually left to domestic manufacturing units or semi-charitable organizations dealing with appropriate technology. There is a need for technical assistance to establish manufacturing units at the intermediate technology level.

G. TRAINING, TECHNOLOGY TRANSFER, AND EDUCATION

Background

69. Training and technology transfer go together and are not truly transferred until the local industry can operate, maintain and repair the related equipment. Training should be practical and "hands-on" wherever possible. Often overseas institutes or organizations provide training at too academic a level and assume wrongly in most cases that the trainees are already skilled in all practical aspects of machining, welding, fitting and installing.

70. The introduction of new equipment and technology will call for the training of the operators as well as the manufacturers and service personnel. To achieve, this requires a coordinated approach involving governments and the business sector.

71. For the small-scale fishery sector, technology transfer can rarely be achieved without the support of a credit programme to enable the fishermen to purchase the new equipment. Few artisanal fishermen have access to institutional sources of credit and special programmes need to be devised to meet their needs.

Manufacturers

72. In general, the training needs will not be limited to the shopfloor worker who will have to deal with machinery and tools to which he or she is unaccustomed. Experience has shown that the training of managers, production engineers and administrative staff is equally important. Where there is a pool of skilled labour, it may only be necessary to give training on the product in question and so the setting up of a manufacturing unit could be accomplished in a short time. In other cases, the introduction of new industry would be a slow process involving overseas training and probably even university studies for those entering high technology industries; all of this in addition to the training of the work force locally.

Servicing

73. The servicing of equipment is a more immediate need since the service is directed to imported as well as locally produced items and in general there is currently a lack of servicing facilities. Factory trained service engineers are highly regarded and any manufacturer hoping to do well in a market must be prepared to ensure the training of field staff and of agents.

National Responsibilities

74. While manufacturers and service engineers have a responsibility to train in order to produce and/or maintain good quality products, governments have a greater responsibility. People with little education can be taught hand skills and such artisans will continue to be in demand, but new technologies in management, manufacturing and design are better transferred to those with a sound education. Governments have that responsibility.

H. CONCLUDING REMARKS

75. Bearing in mind that not all developing countries are ready or willing to accept the responsibilities which go with the manufacturing processes, industrial development in support of the fishing industry cannot and must not be seen in isolation. Shipyards worldwide are not known for their profit-making ability, and many are subsidized. Other manufacturing industries, which are more diversified, such as the makers of refrigeration equipment, oil hydraulics, engines and electrical equipment have a much wider customer base and yet must be

competitive to exist, and few, if any, rely entirely on the fishing industry. For these reasons the drive for self-sufficiency in all things must be tempered by the reality of any "potential" market. The aim of the fishing industry is to serve (by supplying protein-rich products) and to be served by its supporting industries.

76. There is scope for improvement at all levels, from the establishment of large numbers of small businesses in engineering and boat building to the upgrading of the larger shipyards capable of building deep-sea fishing vessels. In some countries progress will be slow, with the need for training and manpower planning on a long-term basis a priority element in the development process. Other countries which are technically self-sufficientwill be required to generate funding to meet their investment needs.

77. What is most likely to affect the rate at which the manufacturing processes can be transferred to developing countries will be the policies of the developed countries regarding trade, of the holders of patents and of transnational corporations.

78. Some transnational corporations have already embarked upon a programme of creating manufacturing units in developing countries. This is not usually motivated by the desire to help such countries. Instead it is a necessity to reduce manufacturing costs to remain competitive. For example, foreign firms have established plants in West Africa to make GRP vessels for local fisherman. They would have preferred to export from their base factories, but shipping costs would have added up to 100 percent to the cost of each boat. In other cases, the transnationals bow to the demands of governments, no submanufacturing, no business. However, such developments are not generally instigated by the fishing industry alone. It is more often the recipient of spin-off benefits which usually require further modification for use in the fisheries harvesting sector.

79. Experience has shown that manufacturing establishments in many developing countries have flourished best when the foreign partner supplying the technology has a continuing interest in the success of the national plant. In such cases the resources of the parent company are available to help the national firm with advice, training, maintenance, or raw materials.

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Improvement of the fish production chain and the increase of added value*

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SUMMARY

The purpose of this document is to identify the major problems relating to the handling, processing and marketing of fish and fish products in developing countries, with the object of promoting discussion about the possible ways of overcoming them and of securing increased added value in the products by means of international co-operation.

It should be mentioned that the range of processing activities in the developing countries extends from the craft level to that of large-scale industrial activities, with a whole series of intermediate situations. This variety is to be noted not only when different regions are compared but also, in many cases, when individual countries are considered.

Broadly speaking, processing activities can be distinguished, according to the destination of the products, as those of the industrial type, geared mainly to export, and as small-scale activities, the products of which are intended mainly for the local market. The problems arising with regard to the training of manpower, technology transfer, equipment, product development, packaging, etc. differ fundamentally in the two cases.

Shortcomings in the infrastructure for the handling of fish, both on landing and on transfer to processing centres and centres of consumption, have been identified as constituting a problem common to almost all the developing countries. In many regions, shortcomings at this level range from shortage of ice and the absence of suitable containers to scarcity of drinking water.

As regards the development of products and technologies, it is to be noted that, in general, the introduction of new technologies into the developing countries has been prompted by external demand, and that those technologies need to be adapted to local conditions. Greater efforts are therefore required to improve technologies in small-scale production (e.g. by energy savings) and to carry on with the work already begun, bearing in mind that, for many developing countries, the local market can only be supplied by products of the craft type. The need for improving the ways in which products are presented and the problem of cans and containers have been identified as common to most of the countries in question, with respect both to canning and to other forms in which the products may be presented.

Lastly, with regard to the improvement of quality control standards, attention is drawn to the need for producers to work in all cases with the governments concerned, this being particularly necessary to improve and maintain the quality of products for export.

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THE HANDLING, PROCESSING AND MARKETING OF FISH IN DEVELOPING COUNTRIES AND THE PRINCIPAL BARRIERS TO IMPROVEMENT

I. OUTLINE OF FISHERIES PRODUCTION - PRODUCTS

1. As shown by the reports on the three regions described at the Preparatory Meetings for the First Consultation on the Fisheries Industry, developing countries with important fishery activities show the following characteristic features: on the one hand, there is considerable internal demand for low-price products and, on the other hand, support is given to exports as a means of generating foreign exchange. This means that production is able to supply contrasting markets with products that are totally different in terms of their consumer appeal, added value and requirements regarding taste, hygiene and presentation (packaging).

2. Besides fresh fish for immediate consumption, a range of industrial products for export and a range of industrial and semi-industrial (craft-type) products to supply the internal market, are thus in many instances being developed.

3. This gives rise to the co-existence of different forms of production around a single landing centre. Hence the difficulty in getting new technologies adopted often lies not in any lack of knowledge of them, but rather in the need for careful adaptation of them to the various scales, cost breakdowns and, primarily, markets to which products are sent. This gives rise to problems relating to the adoption of the appropriate technology for each situation or production cycle and the training of the individuals who have to implement it, as well as their financial and business management capability.

(a) Industrial products for export

4. Although the production of each country or region may differ from others, the need to satisfy the specifications of the international market means that most industrial production falls into the categories covered by the following list:

- Canned products;
- Frozen products;
- Prepared and semi-prepared dishes and pastes;
- Fish meal and fish oil;
- Protein concentrates and special products;
- Fresh fish.

5. Over the past decade, the export of canned products from developing countries, and especially from some countries in Asia, Latin America and North Africa, has increased very considerably. This has been due to various factors such as the existence of raw materials, changes in the profitability of the fish-canning industry in the main consumer markets, the fact that there is a tradition of producing canned goods in the exporting countries, and so forth. None the less, this possibility has not been generally used, since in many countries difficulties are still encountered in adapting production to the varying new market opportunities.

6. Frozen products also play an important role in fisheries exports in some developing countries, especially as regards tuna, shrimp, lobster, squid and white fish. In this area there are extensive opportunities for improvement in the standards of quality and presentation of products.

7. In the field of prepared and semi-prepared dishes and pastes there are many possibilities depending on the way in which market requirements develop. If advantage is to be taken of these opportunities, however, it must be possible to identify them by means of appropriate market information machinery, and to have the necessary technical flexibility to develop the products required.

8. The production of fish meal and oil is largely based on the use of small pelagic species. Although it would be desirable to use more of the supply of these species for direct human consumption, it must be recognized that there are not always markets for them or that they cannot be dealt with industrially and marketed economically. The production of meal and oil has been an important source of income for a group of developing countries, although at the present time the international market in fish meal is being affected by competition from other types of protein meals. Prospects for the future would therefore seem to lie in making better use of the resources for direct consumption and in developing special meals. For this, a good knowledge of the market and in some cases new technologies will be required.

9. The transport by air to certain markets of fresh fish belonging to very high-value species offers the possibility of marketing small quantities of products and obtaining very good prices, which opens up encouraging future prospects for this activity, currently being developed.

10. The future of the so-called "protein concentrates", types A or B or simply fish meal for human consumption, seems doubtful given that there are more appropriate economic alternatives for the direct utilization of fish and strong competition from high-protein meals of vegetable origin.

(b) Products obtained by small-scale operations for domestic supply

- Fresh fish, whole or in cuts, etc;
- Dried, salted and dried, cured products;
- Smoked products, with or without salting and/or drying;
- Fermented products, sauces, marinades and regional products;
- Canned products for internal consumption;
- Frozen gutted whole fish, cuts, etc.

11. The above list attempts to group a very large number of different sorts of products which may be found in developing countries. There is a greater variety of regional products in Asia and less in Latin America. There is not so much diversity in the types of products in Africa but some of them are produced in very large quantities, as for instance smoked and dried fish.

12. The category of products obtained by decrease of water content, by chemical modification or by fermentation processes, offer advantages as compared with frozen and chilled products and also as compared with canned products. The technologies in question involve less investment, less energy cost and can be applied on a small scale.

13. Salted, dried and smoked products are the types whose production can be improved in many areas, mainly in Africa. In particular it is necessary to reduce the losses occurring during processing, storage and distribution in consequence of attack by insects. In this connection there are great possibilities for collaboration among countries in the same region to secure better pooling of technology.

II. HANDLING AND PROCESSING

14. Various types of handling and processing are to be found in the developing countries as a whole, ranging from simple small-scale fishery activities, often difficult to distinguish from subsistence fishing, to modern industrial systems comparable with similar systems in developed countries, with a whole range of intermediate possibilities, often coexisting simultaneously. The success achieved in various developing countries with activities of the industrial type has been due to a variety of reasons, among which mention should be made of the existence of raw materials, the identification and/or development of markets, the presence of qualified manpower and industrial experience in similar activities. There have also been failures due to inadequate planning, uncertain policies and inadequate training, including management training.

15. Widely differing situations may also be found even within the same country, as a result of a combination of planning mistakes and failures or of differences in the assimilation of technologies by the various people intended to use them. Those engaged in small-scale "craft" production frequently show resistance to the possibility of positive change through failure to appreciate its advantages due to inadequate preparation of the social environment and technical training.

16. A problem shared by almost all developing countries, with differences from one region to another, is the deficiency of the infrastructure for the handling of fish when it is landed, and delay in its despatch to the factories for industrial processing. It is common, in some regions, for there to be not enough ice, suitable containers, cold storage or even drinking water available at this stage. Similarly, there are serious deficiencies in transportation to the locations where the resource is used for processing or sale.

17. Production of the industrial types is affected, in many developing countries, by the shortage of spare parts for machinery and plant. This problem is aggravated in the present economic situation by the shortage of foreign currency. The maintenance of machinery and plant is thus found to be defective, especially in those countries which are short of specialized manpower. It is also noticeable that the efficiency of machinery and plant from the point of view of its use and energy consumption, is in many cases far below the level of efficiency achieved with the same machinery and plant in developed countries. This applies particularly to the production of ice and the storage and transport of fresh and frozen fish, with consequent increases in costs.

18. If we look at the various processing and value-adding activities separately, some of the salient features are as follows:

19. Canning. In the three regions, there are relatively small plants and also very modern plants with large-scale production. Above all, during the past decade, there has been an expansion of the canning industry in the developing countries, in many cases directed to the export market but sometimes also to the domestic market or in pursuit of several aims simultaneously. This development has certainly not been homogeneous and in many countries there are still problems as, for example: shortage of raw material in adequate quantities or of suitable quality, too small a market for the size of the undertaking, difficulties in meeting the quality requirements for foreign markets etc. At the present time, the canning industry is

passing through a period of change throughout the world, which may offer opportunity for the developing countries, provided that they are able to adapt to market requirements. The common problem is that of the cans themselves which, as a rule, are of outdated technology and too expensive, thus preventing them from competing more successfully on the international market. In the three regions, attempts are being made to achieve modernization in the direction of using easy-to-open containers, and even flexible containers in Chile, Peru and Brazil. Another factor limiting the quality and competitiveness of some canned products is the quality of the oil available. The problem of the type of cans or the shortage thereof may perhaps be solved by subregional co-operation or by making use of temporary import facilities.

20. Freezing. It is in this branch that the problem of maintenance is most acute, especially in tropical conditions. The range of products and forms of work is very wide. The ice supply normally needed for this activity is insufficient in many countries and the type of ice used is frequently inadequate.

21. The mistaken evaluation often made of the benefits of using a particular type of ice for conserving fish arises generally from the absence of facilities (insulated silos or containers) to avoid ice loss before use. Likewise, the attitude towards fresh and frozen products would change fundamentally if one were able to implement low-cost cold storage chains based on the use of efficient and economical insulated containers. It must be borne in mind here that, if the implementation of these systems is to be economically feasible, a certain scale must be reached in order to justify the application of expensive means of transport and distribution.

22. If products for direct human consumption alone are considered, freezing is the approach adopted for most international trade. The possibilities of this trade have given rise in many developing countries to substantial investments, technological advances and general development in the fisheries sector.

23. Reduction. Reduction to obtain fish meal and oil is the largest activity in Latin America. In Asia there is also extensive production, but the quality does not always meet the highest standards, since the industry uses the accompanying catch which is somewhat carelessly handled and contains large amounts of sand.

24. Overall, this industry is considerably over-sized, mainly owing to the drop in production in Peru and the loss of competitiveness of fish meal in the face of vegetable substitutes such as soya. This is probably the industrial fishing

activity with the greatest degree of standardization and mechanization and in which there are the fewest small-scale undertakings. It is also that which corresponds most to the idea of an industrial activity involving the application of large investments and employing little labour. Most of the fish meal produced by the developing countries is intended to export.

25. Salting and drying. These processes are very important in relation to domestic supply, since they represent, together with smoking, cooking and some types of canning, the only alternative in the absence of cold storage chains. There is much to do in this field to improve traditional practices and to reduce the losses during processing, storage and transport, which are considerable in some regions. The key points are: improvement of sun drying, increased production or availability of salt, improved handling, protection against insects, use of appropriate standards and improvement of packaging. In general terms, the small-scale processing workers are familiar with these technologies, which also form part of the culture of many peoples, but in many instances procedures can be improved in the light of present-day knowledge.

26. It is worth noting that there are real possibilities of enhancing the production, productivity, hygiene and quality of most preserved products. However, it is even more important to note that this can be achieved by using simple methods, with locally-available materials and very little mechanization (if any), while at the same time improving the working and living conditions of the small-scale processors.

27. Smoking. For smoked products of the type familiar in the developed countries the possibilities of expansion in the developing countries are slight, owing to the short time they can be kept and to the need for a chain of cold stores for their distribution. There is, however, one type of product, more correctly described as smoked and dried, produced mainly in Africa, which can be stocked for an adequate time and does not require a cold storage chain. This type of product can be improved by using better techniques and processes, while losses during processing storage and distribution need to be reduced. The introduction of improved smoking ovens and the more efficient use of the wood-fuel employed would contribute to this end.

28. Fermented products. There are traditional techniques in this area, especially in Asia and North Africa. Sauces are produced in Asia which, when suitably packed, are exported. The technology used is based on traditional techniques, but there are also methods developed locally for industrial-type production.

29. If this industrial production prospers and there are improvements in the hygiene conditions for the processing of this type of product, this may be a new and important export item for some countries, especially with the world-wide expansion of oriental cookery.

III. DEVELOPMENT OF PRODUCTS AND TECHNOLOGIES

30. In general, the introduction of new technologies in developing countries is motivated by external demand for a product for which the technology already exists in the consumer market. It is therefore normally a matter of the assimilation of existing technologies and their adaptation to local conditions. Certain efforts are also being made to develop craft-type technologies which can help in improving living standards in rural communities.

31. Certain countries in Latin America and Asia have reached a level of industrial development which enables them to manufacture refrigerating equipment and processing machinery, containers, etc. not only for their own consumption but also for export. In such cases, the only things that need to be imported are highly specialized electronic, automatic-control and precision-engineering components, such as centrifuges for the separation of water and oil in the producton of meal. The developing countries are not, however, taking part in the computerization of production processes and the quality control systems employed are still somewhat antiquated.

32. This systematic adoption and adaptation of technologies to suit local conditions has produced good results in terms of foreign exchange savings, technological independence and independent supply and has led to the improvement of some existing machines and implements.

33. The fact that the technologies and types of products for which there is a demand in the international market originate in developed countries means that there is a fundamental task of adapting them to local conditions. Furthermore, the many activities thus generated lead to increased employment of labour in tasks related to the fisheries industry.

IV. POSSIBILITIES OF CO-OPERATION BETWEEN DEVELOPING COUNTRIES

34. Considering that the situations encountered in the various countries show very marked differences and that experience in fishery activities is very varied, there are considerable possibilities for technological co-operation between the different

developing countries. For example, in some countries in Asia and Latin America there is a good knowledge of processing techniques that are applicable in other regions and can give very good quality products. Nor should internal transfer of technology be neglected, since there are, in many instances, marked differences between the various regions of the same country.

35. Some countries have experience in the conclusion of international agreements and the establishment of joint enterprises. Others are familiar with aquaculture, the processing of white fish, shrimp and prawn, fish meal, etc: it must be acknowledged that it is not easy to promote the interchange of knowledge but advances in this direction have none the less been made and some regions are more active than others in this respect.

36. There is thus enormous scope for collaboration on the design and adaptation of the technologies most appropriate in each case.

37. A fundamental point in technology transfer relates to the practical training of technical personnel in processing, maintenance and even business management. So far as possible, the training aspect should include the acquisition of knowledge connected with the tasks involved in "managing" an enterprise. Any improvement project along the lines mentioned may depend on this.

38. Likewise, the field of containers and packaging in general offers interesting possibilities for South-South co-operation.

V. QUALITY CONTROL AND STANDARDS

39. Experience has shown that, for market purposes, the quality of the fisheries products exported by many developing countries has not been maintained at a steady and consistent level. In consequence, these countries have lost millions of dollars in earnings, due to the detention and rejection of their shipments, and to the low prices commanded by their products in the main world markets because of this lack of consistency and continuity. Programmes for the improvement of quality control and in many cases of hygiene are required, both at government level and at the production level, in order to improve this situation. Such programmes must be well planned and administered and should cover all stages from catching to processing. There are, admittedly, differences between the regions and even among the countries in any one region, and substantial advances have also been made over the last decade. Nevertheless, if they are to derive the maximum economic benefits

and not to be left behind by the latest technical developments and new ideas, the developing countries must renew their efforts to improve the quality of their products, from the standpoints of hygiene, consumer appeal, presentation and labelling.

40. The developing countries have not taken a very active part in formulating the recommended codes of practice for fisheries products. Although these codes are still far from being internationally recognized, they constitute the only integrated body of standards in this respect which has been discussed multilaterally. The developing countries should therefore consider more active participation in the discussions on the Codex Alimentarius (FAO/WHO), so that account may be taken of their views and circumstances in the formulation of standards and codes.

VI. THE PRINCIPAL BARRIERS TO THE IMPROVEMENT OF FISHERY ACTIVITIES WITH REGARD TO HANDLING AND PROCESSING IN DEVELOPING COUNTRIES

41. Bearing in mind the existing situation in the developing countries, the following comments may be made with regard to the problems those countries have to face in trying to produce more and better products in order to satisfy the demands of the various markets.

- Problems concerning maintenance and technical assistance for the industry.

42. Possibilities for ensuring adequate maintenance of industrial equipment and installations are absolutely essential to ensure the self-sustaining development of the industry in many developing countries, particularly in those of Africa South of the Sahara. Access to such assistance generally depends on government policies, which should take this problem into account. In principle, fishery activities should be enabled to obtain the external assistance needed, while local teams of technical experts are trained. Similarly, efficient circuits must be established for the prompt supply of spares and components.

- Continuous supply of electricity, water and fuel.

43. The development of industrial activity relating to highly perishable products is impossible unless these inputs are reasonably guaranteed.

- Absence of service infrastructure.

44. Self-sustaining fisheries undertakings are impossible unless there is a basic infrastructure for the supply of water, channels of communication, transport, national and international communications, etc: it should be noted that, in many cases, there are shortcomings in the internal distribution of fisheries products and that the wholesale and retail markets are inadequate.

- Need for appropriate technologies and economic scales.

45. Any development and/or modernization of fishery activities must pay close attention to these two aspects to ascertain to what extent conditions can be improved by the appropriate application of existing techniques and approaches and to what extent it is really necessary and advisable to introduce new techniques, equipment and mechanization.

- Supply of raw material and basic inputs, such as salt, ice and cans.

46. There are numerous examples of the results of making large investments in modern installations without a sound foundation with regard to the provision of raw material and such basic inputs as cans, ice and salt. It is often necessary to plan the development of fishery activities and of ancillary industries simultaneously.

- Absence of an infrastructure to land the catch and handle it on shore.

47. A point which should be mentioned is the absence of facilities to improve the handling, landing and collection of the fish, not only in the case of small-scale fishing but very often in that of industrial fisheries. This affects the entire subsequent cycle and increases fish losses. In many instances, the provision of very simple installations could provide a substantial improvement in the situation.

- Inappropriate handling.

48. Although the absence of an adequate infrastructure causes handling problems, handling can also be improved by educating the people involved so as to avoid practices which may be prejudicial to the quality of the products.

- Lack of storage installations for materials and products.

49. It is, in many cases, common knowledge that facilities of this type are lacking, both at the locations where catches are landed and at the distribution centres, as well as in the fishing communities. Losses are consequently caused by climate, insects and dirt. In the case of craft-type products, where the preserving method is associated with decrease of water content, there are possibilities of improving storage conditions by using simple approaches within the means of the fishermen.

- Need to diversify export products.

50. Producers must strive to avoid excessive dependence on a single market or a small number of markets or products, in order to achieve greater security.

- Technological dependence.

51. The processing know-how and even the necessary machinery and equipment are very often purchased from the same countries that buy the final products. This leads to a situation of dependence calling for efforts to reduce it. Complete independence will not be possible, as communication and unimpeded dialogue between the exporting and importing countries is desirable.

- Lack of technical training.

52. In many countries, there is a need for trained personnel at all levels of fishery activities. Efforts must be made to form an initial nucleus of technicians who can then pass on their knowledge and to develop a policy for promoting the transfer of knowledge from research and training institutes to the production sector.

- Need to improve salted, dried, smoked and fermented products.

53. Some traditional production techniques do not result in products which are stable from the points of view of hygiene, keeping qualities or nutritive properties. It is therefore necessary to review the methods and the final properties of the products to tailor them to requirements in each case.

- Need to establish the correct scale for each branch of activity.

54. One problem frequently encountered is the lack of information for determining the size of a given undertaking by reference to the available fisheries resources or for avoiding the risk of production on an uneconomic scale.

- Absence of official quality and health control in many countries.
- Inadequate development of can-making technology and production.

55. One important advance which should be achieved in the future would be the refinement of the ways of packaging products obtained on a small scale and using craft-type methods; such products suffer severe losses, partly because they are inadequately packaged.